

Auto Intelligence

Essential Information for the Modern Workshop | Issue 12 | Autumn 2010



BOSCH
Invented for life

Automechanika 2010

Bosch showcases its latest equipment for service and repair of new automotive technologies.



The Bosch group had a large stand at this year's Automechanika trade fair in Frankfurt, with Bosch, Beissbarth, Sicam and HC Cargo exhibiting all the latest parts and equipment. Another interesting exhibit was a recreation of a Bosch Car Service workshop, fully kitted

out with the latest range of garage equipment and car parts.

If you were unable to attend the Automechanika show this year, we have created a virtual tour of the Bosch stand

where you can see all the latest products from the four companies and see all the brochures, videos and graphic boards that were on show. The virtual tour can be found on the following web link:
www.bosch-aa-messestand.de

Some exciting products were shown for the first time on the Bosch stand. Ranging from a small hand-held battery tester to the latest diesel test bench. These will all be launched in 2011.

EPS 708

The new Bosch EPS 708 was developed especially for the testing of Common Rail components including piezo injectors and is designed for test pressures of up to 2,200 bar. It has a completely redesigned clamping set for up to six car injectors to be tested. In addition, the multiple clamp set can also test up to four commercial vehicle injectors. All accessories for the EPS 708 are compatible with the EPS 815. The latest EPS add-on is the piezo Common Rail injector retrofit kit, which can be used to test modern injector systems from Bosch, Denso and Siemens/Continental. The testing of Delphi injectors is currently in preparation.

FSA 050 and FSA 500 – New hybrid tools

The new FSA 050 was designed especially for measurements on the high-voltage components of electric and hybrid vehicles. It is a high-voltage multi-meter that can communicate via Bluetooth with the FSA 500 and the FSA 7 range, but can also operate on its own as a high-voltage tester.

Offering a convenient entry into the testing of electrical and electronic systems. The FSA 500 features an engine test function, a scope with two or four channels, an ignition scope, a two-channel multi-meter, a signal generator and a component test function. The CAN signals from the networks fitted in the vehicle can also be displayed graphically. The FSA 500 can be used in combination with the FSA 050 to test hybrid and electric vehicles.

ACS 751

Certified to the highest automotive standard (SAE-J-2788) the ACS 751 ensures that you can discharge and fill the vehicle

refrigerant with the highest accuracy. The new design makes the equipment highly mobile and features a status indicator light that can be seen from all angles.

BAT 490

This compact but powerful battery charger is suitable for charging all 12V or 24V lead-acid batteries, particularly batteries with fixed electrolyte, gel or AGM batteries. The charger's floating-mode operation stabilizes the vehicle's electrical system during the diagnosis and reprogramming of control units.

BAT 131

The new portable BAT 131 battery tester is suitable for testing 6V and 12V starter batteries (lead-acid, gel and AGM batteries). The cold cranking current can be set as required between 100 and 2,000A according to the standards CCA, JIS, SAE, EN, DIN and IEC. The load free test procedure provides fast, precise and reliable measurement.

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Welcome

Welcome to issue 12 of Auto Intelligence. The recent Automechanika trade show saw a raft of new products being launched by Bosch, as you will have seen from our cover story, and this reflects the great demand from the automotive service and repair market for increasingly sophisticated equipment.

This issue also features articles on brake fluid (page 3); often overlooked but a vital safety component; biodiesel (page 3) and its compatibility with modern fuel systems, plus a technical overview of GDI technology (page 6) and finally on page 8, why quality counts when it comes to glow plugs.



Bowled over

Bosch Workshop Concepts Manager receives sports award.

Howard Price, Bosch Workshop Concepts Manager, has been presented with an award by cricket legend Mike Atherton on behalf of the England and Wales Cricket Board Coach Education Programme, run in conjunction with Sky Sports. Howard's award recognises his contribution to cricket coaching in taking the Hertfordshire County U13 girls' team to success in the ECB Development East League last year.

Howard was presented with his certificate of recognition from England legend and cricket pundit, Mike Atherton, at The Oval. "It's been a great day and very unexpected", said Howard, continuing: "We do what we do for the love of coaching so the warmth and generosity we have been shown here today is fantastic."

Boiling point

Bosch now offers a boiling point brake fluid tester.

The BFT 100 brake fluid tester operates using the boiling point method, the only precise testing method for brake fluid. Powered by the vehicle battery (12V) the unit features a user-friendly menu. The boiling point test results are compared with the minimum values of the DOT standard, which are stored in the tester. Testing takes 30 seconds and the BFT 100 is suitable for DOT3, DOT4, DOT4 Super, DOT4 HP and DOT5.1 brake fluids.



DXP software allows multiple pieces of PC based diagnostic equipment to networked

Workshop networking

New DXP workshop networking software to be launched by Bosch.

In order to perform comprehensive vehicle diagnostics using multiple test and analysis systems, the workshop mechanic currently has to newly identify and re-register the vehicle on every system. With the new DXP workshop networking software from Bosch (unveiled at this year's Automechanika trade show) the vehicle data established on one system is immediately available on

all other PC-assisted diagnostic systems, from Bosch and Beissbarth. Once a vehicle has been identified, the mechanic only has to enter the vehicle registration number or VIN (vehicle identification number) at the relevant workstation to gain access to all vehicle data. The unique Bosch vehicle identification data and the diagnostics results of each individual system are exchanged between the systems. The DXP software required for the data

exchange can be installed on any recent workshop PC and is activated for workshop networking via a license code, in the same way as ESI[tronic]. The DXP software is compatible with any recent workshop PC. However, Bosch recommends that a separate server be set up which best meets the technical requirements for the network. This server can be preconfigured and simplifies the network setup process.

Hybrid training

Bosch now offers IMI awards qualification (QCF) for Hybrid Electric Vehicles.

With Hybrid Electric Vehicles (HEV's) increasing in popularity, garage technicians will become progressively more involved in the servicing and repair of these vehicles, and need to be aware of the risks and hazards present whilst working on these vehicles.

The new two day course, compiled by Bosch, delivers the knowledge required to work safely around a vehicle's hybrid system, whilst carrying out repairs or maintenance.

This IMI Awards Level 2 QCF (Qualifications and Credit Framework) qualification comprises the first unit of the Level 3 Award in Hybrid Electric Vehicle Repair and Replacement QCF (Ref: 500/7150/6). However, this Level 2 qualification can also be completed as a standalone unit.

IMI Awards require applicants to already have vehicle maintenance and repair



knowledge and skills at Level 2 technicians holding a level 2 qualification (or higher) in automotive service and repair, or with proof of a minimum of two years workshop experience at service level, may attend this course.

Course content:

- ▶ Hybrid system components and operation
- ▶ How to work safely on hybrid and related vehicle systems
- ▶ Maintenance and repair methods when working on hybrid vehicles

For more information contact:

The Bosch Training Dept: 01895 878032

Clean sweep

Bosch wipers achieve 'clean sweep' in Auto Express product test.

Bosch has followed up its Auto Express 'Best Buy' verdict for its Aerotwin wiper blade with a 'Best Buy' recommendation for its Super Plus blades in a product test looking at conventional blades. The magazine tested the Bosch Super Plus blades against competitors' products, noting its "excellent performance" and that they were also one of the quietest blades.

Bosch Super Plus blades are made with high-quality dual rubber, with a soft rubber spine giving them an effective flip-over function and a hard rubber wiping edge to ensure the best performance on the screen. Auto Express also praised the pre-mounted universal 'Quick-Clip' adapter on the Super Plus blades, which means that they will fit 85% of vehicle applications – avoiding the need to search for the right clip for a specific vehicle.

Biodiesel for modern systems

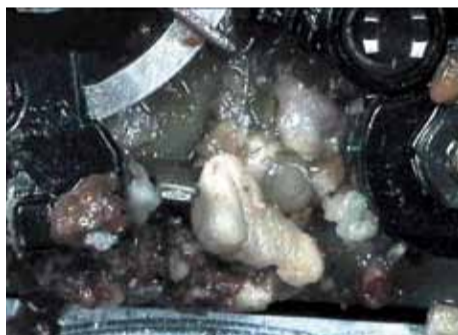
Seen as an environmentally friendly, renewable resource, the use of biofuels has become increasingly common in recent years. But not all fuels are right for diesel engines. To comply with the Euro 5 and 6 emissions standards, biofuels must meet certain requirements.

What is biodiesel?

Biodiesel is an umbrella term covering various chemical compounds. It comes in variants based on rapeseed, soya, and plant or cooking oil. In Europe and the USA, biofuels must meet minimum legal requirements, and are used mostly as additives to mineral diesel fuel. The European Standard (EN 590) stipulates the addition of up to 7% (B7) biodiesel is acceptable for use in current engines.

Which fuel should be used, and which should not?

Car and truck drivers can use B7 standard



Bacteria in the tank due to mixing with the wrong biodiesel

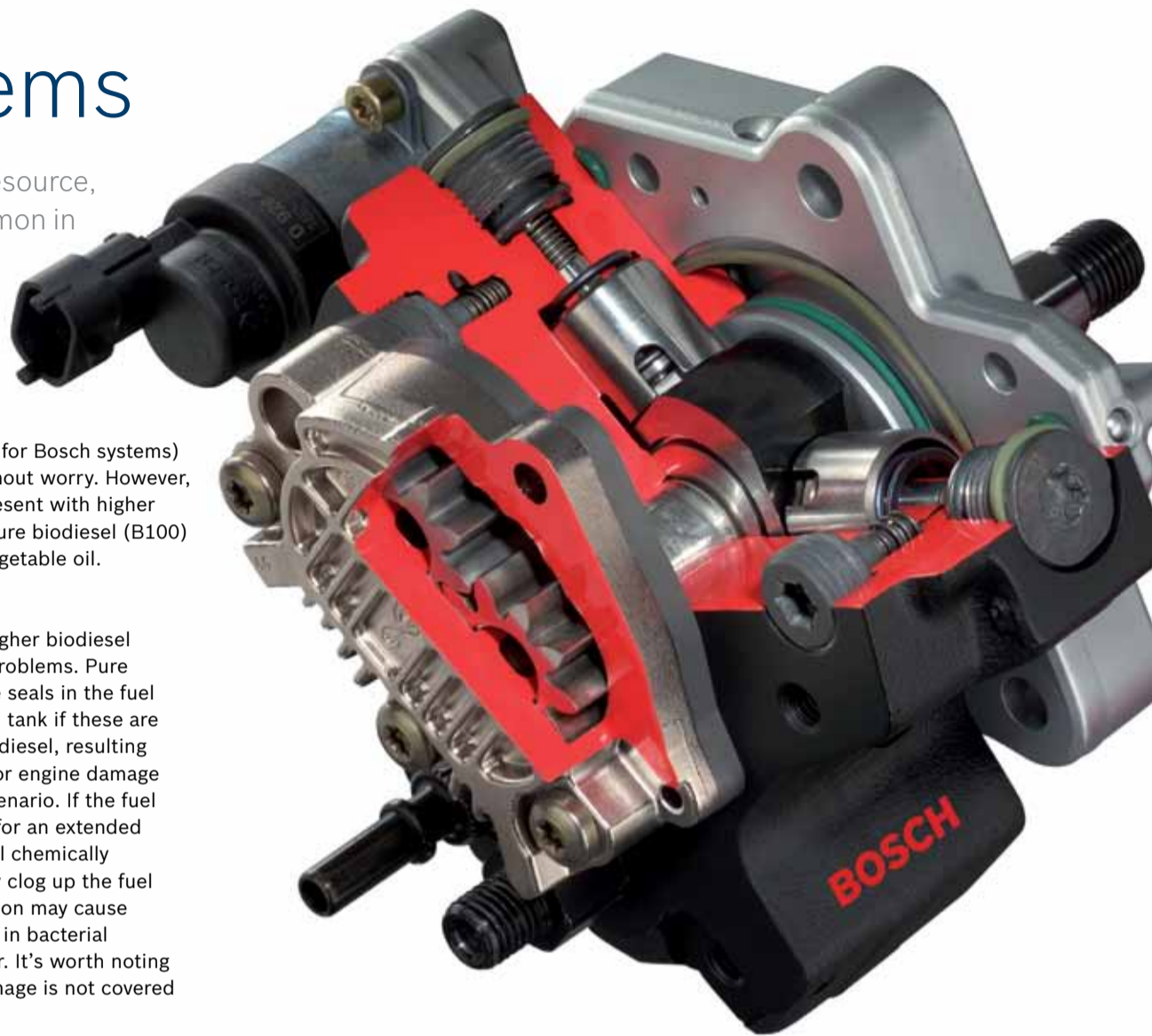
biodiesel (approved for Bosch systems) in their vehicles without worry. However, critical levels are present with higher biodiesel content, pure biodiesel (B100) or pure plant and vegetable oil.

Risks to systems

Using fuels with a higher biodiesel content can cause problems. Pure biofuels can corrode seals in the fuel injection system and tank if these are not designed for biodiesel, resulting in possible leakage or engine damage in the worst-case scenario. If the fuel remains in the tank for an extended period of time, it will chemically decompose and may clog up the fuel lines. Water separation may cause corrosion and result in bacterial deposits on the filter. It's worth noting that this type of damage is not covered by warranty!

Higher consumption and emissions

In addition to the technical risks, biodiesel also has a lower calorific value than conventional diesel. As a result, fuel consumption is increased by as much as 10% and the vehicle is



no longer able to comply with the key emissions standards.

B7 standard for optimum performance

State-of-the-art diesel injection systems from Bosch meet the highest demands in

terms of performance, fuel consumption and emissions. The minimum standard for diesel fuel quality ensures these systems can run with optimum combustion and consumption characteristics whilst maintaining emissions control and system longevity.

Fluid facts

Motorists often underestimate the importance of brake fluid and how critical it is for the operation of the braking system. Bosch explains why you should emphasize the need to check and replace this vital fluid component.

Brake fluid should be changed on a regular basis, normally every two years regardless of the mileage. This fluid is hygroscopic, which means that it will absorb moisture over time, reducing its effectiveness. Failure of the brake fluid to transfer the braking pressure to the calipers could result in a severe accident.

System damage

The life of brake fluid is limited not only by the absorption of water but also the depletion of the rust inhibitors within it. Wear and tear can result in a build-up of particles and rubber fragments collecting in the fluid. Since modern braking components are built to strict tolerances any debris in the fluid or corrosion build-up within the system due to moisture and poor

performance of the rust inhibitors, could damage these components.

Costly repairs

Besides the risk of an accident poor condition of the brake fluid could

result in costly repairs to the braking system. Brake calipers, wheel cylinders or master cylinders are relatively less expensive to replace compared to an ABS/ESP modulator. The construction of a modulator pump is very delicate and could easily be compromised by debris or corrosion resulting in brake malfunction and a costly repair for the customer.

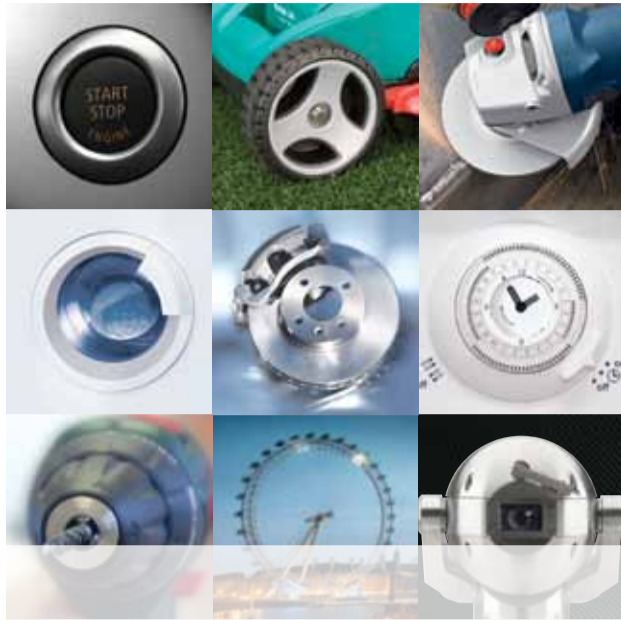
Boiling point

Brake fluid is subjected to very high temperatures due to the heat transferred through the calipers. While these fluids are designed to withstand these temperatures, any moisture absorbed in the fluid reduces

its boiling point. If it does boil it turns into vapour, which can be compressed easily resulting in the brake pedal sinking towards the floor and the pressure generated being absorbed rather than transferred to the wheels.

It's worth noting that as little as 3% of moisture in the brake fluid can reduce its boiling point by 100°C. So it is crucial that brake fluid is regularly tested using a suitable brake fluid tester (such as the Bosch BFT100) and should be replaced as recommended by the vehicle manufacturers, which is normally every two years.





Did you know?

As well as being one of the world's largest independent manufacturers of automotive parts and systems, Bosch is made up of numerous divisions with expertise in different sectors.

The Power Tools division produces a wide range of equipment for both professional and DIY users.

Bosch Rexroth AG specializes in drive and control technologies, supplying over 500,000 customers with solutions for driving, controlling and moving machinery used in both factory and mobile applications.

The domestic sector is well catered for with the Lawn & Garden division and BSH Home Appliances Ltd (a 50/50 joint venture with Siemens) supplying high performance, innovative products to the market.

Bosch Security Systems is a one-stop-shop for high quality security and communication products, offering CCTV, intrusion systems, conferencing, public address, social alarms and IP network video.

Combining the Worcester and Buderus brands, Bosch Thermotechnology UK Ltd is one of the largest suppliers of heating products in Europe. The brands offer energy efficient and environmentally friendly heating and hot-water solutions to the market.

Bosch Packaging Services develops intelligent packaging technology for the food, pharmaceutical, chemicals and cosmetics industry. As a wholly owned subsidiary ETAS Ltd provides the automotive industry with tools and solutions for the development and service of automotive Electronic Control Units.

Providing solutions for business processes, information technology and mechanical engineering, the Bosch Business Solutions division is a global service provider with a presence in Europe, US and Asia-Pacific regions.

Bosch Healthcare is the newest regional subsidiary delivering patient management solutions to the UK healthcare market to help the NHS and private practices streamline time and budgets.

Inside story

For some people the name Bosch is associated with power tools and dishwashers, but for others it is brand synonymous with the latest automotive technology, high quality components, diagnostic equipment and training.

We're using this opportunity to show you just how much of a typical modern vehicle functions using Bosch control systems and components. Take a look at the 'Glass Car' on these pages to see the extent of Bosch parts and systems in use.

Engine management

- | | | |
|---|---|---------------------------------------|
| 01. Unit Injector | 13. Particulate Filter Control | 26. Planar Wide-Band Lambda Sensor |
| 02. Hot Forged Rail | 14. Charge-Air Temperature Sensor | 27. Switching-Type Exhaust Gas Sensor |
| 03. Common Rail Piezo Injector | 15. Water Temperature Sensor | 28. Accelerator Pedal Module |
| 04. Common Rail Solenoid Valve Injector | 16. Rotational-Speed Sensor | 29. Electronic Control Unit |
| 05. Piezo Injector – GDI | 17. Charge-Air Pressure Sensor | 30. Electrical Fuel Pump |
| 06. SVI – Gasoline | 18. Pneumatic Exhaust Gas Recirculation Valve | 31. Ignition Leads |
| 07. Common Rail Pressure Sensor | 19. Intake Air Temperature Sensor | 32. Secondary Air Pump |
| 08. Pump Speed Sensor | 20. Hot Film Air-Mass Meter | 33. Fuel Rail |
| 09. High Pressure Pump Diesel | 21. Fuel Temperature Sensor | 34. High Pressure Pump – Gasoline |
| 10. Denoxtronic PC/LD Dosing Module | 22. Pressure Sensor | 35. High Pressure Fuel Injector |
| 11. Denoxtronic PC/LD Supply Module | 23. Temperature Sensor | 36. Single Spark Ignition Coil |
| 12. Electronic Diesel Control | 24. Phase Sensor | 37. Ignition Coil Module |
| | 25. Knock Sensor | 38. Canister Purge Valve |
| | | 39. Crankshaft Speed Sensor |



Lambda sensors

Bosch is the largest OE supplier, having the biggest aftermarket range and the widest vehicle coverage. Genuinely the number one.



Air mass meters

Bosch only offers genuine OE parts as manufactured by Bosch. Imitations are proven to compromise engine power, economy and exhaust emissions.



Electric fuel pumps

Bosch offers several aftermarket solutions available for a wide vehicle parc. Quality is always OE and never compromised.



Ignition coils

Bosch offers the widest range to the aftermarket from a single source. Every one an original equipment part.



Pads and discs

Bosch offers a comprehensive range of pads and discs consisting of approximately 900 pads and 1,300 discs covering 96% of the vehicle parc.



TOP 100 Parts and Systems



- 40. Electronic Throttle Body
- 41. Fuel Pressure Regulator – Gasoline
- Braking**
- 42. Mechanical Brake Assist
- 43. Brake Calipers
- 44. Brake Pads
- 45. Brake Discs
- 46. Wheel-Speed Sensor
- 47. Antilock Braking System ABS
- 48. Electronic Stability Program ESP®
- 49. Brake Master Cylinder
- 50. Brake Booster
- 51. Automatic Parking Brake
- 52. Brake Drums

- 53. Angular-Rate Sensor
- 54. Yaw-Rate and Lateral-Acceleration Sensor
- 55. Brake Shoes
- 56. Handbrake Cables
- 57. Brake Hoses
- 58. Wheel Cylinders
- Chassis Electronics**
- 59. Engine Cooling Fan Motor
- 60. Ultrasonic Sensor (Parkpilot)
- 61. Dual Fan Module
- 62. Electric Power Steering
- 63. Electrohydraulic Transmission Module
- 64. Transmission Control

- 65. Torque Sensor Steering
- 66. Water Valves
- 67. Alarm Siren
- 68. Wiper Motor
- 69. Peripheral Pressure Sensor
- 70. Steering-Angle Sensor
- 71. Seat Actuator
- 72. Occupant Weight Sensing
- 73. Blower Controller
- 74. Window Lift Drive
- 75. Sliding-Sunroof Drive
- 76. Relays
- 77. Rain Sensor
- 78. Climate Control Sensor

- 79. Upfront Parking Sensor
- 80. Adaptive Cruise Control
- 81. Airbag Control Unit
- 82. Electric Water Pump
- Plugs**
- 83. Spark Plug
- 84. Glow Plug
- Wiper Systems**
- 85. Aerotwin Wiper Blade
- 86. Wiper Linkage
- 87. Windscreen Wiper Arm
- Lighting**
- 88. Bulbs
- 89. Bosch Xenon Headlight

- Rotating Electrics**
- 90. Integrated Motor Generator
- 91. Alternator
- 92. Starter Motor
- 93. Stop/Start
- Batteries**
- 94. Battery
- 95. Electronic Battery Management
- 96. Electronic Battery Sensor
- Filters**
- 97. Air Filter
- 98. Cabin Filter
- 99. Fuel Filter
- 100. Oil filter



Calipers
Bosch OE calipers developed for the production of new vehicles are also available to the IAM alongside the exchange programme.

Piezo injectors
Fast acting piezo ceramic actuator technology provides smoother performance and better efficiency – innovation from the world no.1 in diesel systems

Diesel pumps
The latest Bosch systems utilize CP4 pumps, which have a lighter aluminium body and dual cam technology to allow more flexible pressure generation.

Batteries
Exact fitment for all vehicles, always meeting OE specifications – even for start-stop vehicles.

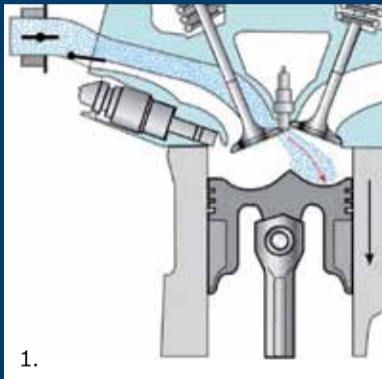
Filters
OE quality is always met. This applies not only to the quality of the product, but also the design and fitment of the filter.

Plugs
Whether glow or spark, our plugs ensure the smooth running of your engine, ensuring the life and performance of your vehicle.

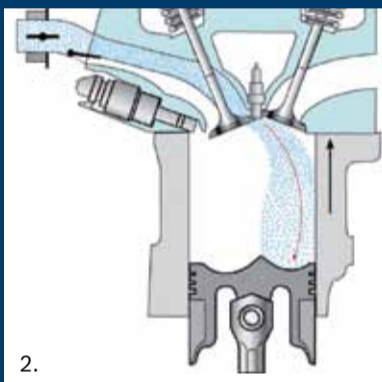
Wiper systems
New! Aerotwin (flat blades) SINGLES with Multi-Clip adapter – pre-assembled Multi-Clip adapter compatible with the four main wiper arm connections.

Lighting
Which?, the largest independent consumer organisation in the UK, has recommended Bosch's Pure Light H7 headlight bulbs as a 'Best Buy'.

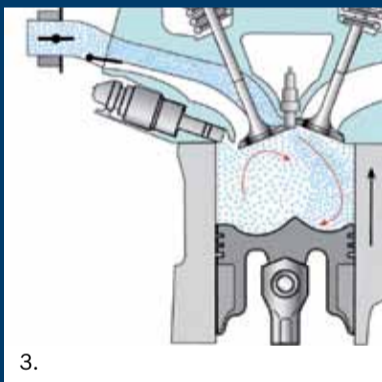
To achieve both types of combustion, the design of the engine's combustion chamber is unique.



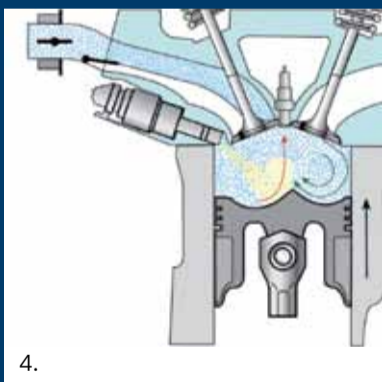
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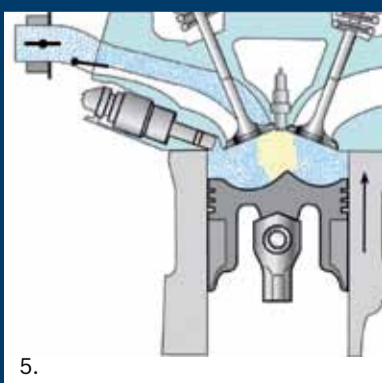
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GDI and lean-burn engines

Bosch has been at the forefront of petrol injection development for over fifty years. This article looks at Gasoline Direct Injection (GDI) and how it functions to provide both low emissions and high performance.



Paul Alder
Product Specialist:
Petrol Injection/
Comfort Electronics

The basic principle on which the petrol engine operates has not fundamentally changed since it was first used in a motor vehicle over a hundred years ago. However, engine technology has undergone a process of constant advancement and in the last three decades has accelerated at a rapid rate. One of the major contributors to this has been the changeover from mechanical to electronic control of engine management systems.

Advancements in vehicle technology, design concepts, materials, and electronics with regard to the engine combined with the need to meet increasingly strict engine emissions legislation has paved the way to the widespread introduction of Gasoline Direct Injection. This system differs from the traditional manifold injection not only in that the fuel is injected directly into the combustion chamber, but also the way in which the air/fuel mixture burns under different engine conditions.

Lean-burn

These GDI engines are capable of running in a lean-burn mode when required. Lean burn operation is achieved by switching the engine's combustion process from homogenous (the traditional engine management system controlled to run at an air to fuel ratio of 14.75 to 1; lambda 1) to what's known as stratified combustion. When switched to stratified combustion the air to fuel ratio will be very weak; lambda 4 is possible. To measure this, the use of a wideband lambda sensor to measure the exhaust composition upstream of the catalytic converter is essential. Stratified combustion is most common when the vehicle is idling, but the engine

may also switch between the two modes of combustion at any time the engine management system requests.

Stratified combustion

Stratified combustion is traditionally used on diesel engines where the fuel is injected into a chamber that's already partially charged with swirling air. With diesel, as the fuel is injected, it's immediately ignited causing it to instantly mix and burn. The fuel burns at combustible ratios, but only in the centre of the cylinder. The outside areas of the cylinder remain charged with pure air, which acts as insulation between the burning fuel and the cylinder walls. This situation leads to more of the heat being converted into power rather than being transferred into the cooling system. In addition, the overall air to fuel ratio is much higher, giving the stratified method clear advantages in both economy and emissions.

The need to meet increasingly strict engine emissions legislation has paved the way to the widespread introduction of Gasoline Direct Injection.

Using the stratified method alone on petrol engines has never been considered a viable option. This is mainly because petrol has different properties to diesel, resulting in a loss of engine power and torque at such weak mixtures, resulting in poor power output when the engine is under load. However, the emission and economy advantages remain and therefore the key to the success of these engines is that they can operate by switching between stratified combustion and normal homogenous combustion as required by the engine load. This improves emissions and economy

whilst maintaining good performance when it's needed.

Combustion

To achieve both types of combustion, the design of the engine's combustion chamber is unique. At first glance, it looks like a diesel engine. The injector is deliberately positioned just under the inlet valve and the piston contains a large recess on the intake side, which is used to swirl the fuel. On the outlet side of the piston is a smaller recess, which is used to swirl the induced air. The inlet manifold contains one throttle valve and one tumble flap per cylinder. The manifold is divided into an upper and a lower channel and when the flaps are actuated, the lower channel is completely closed.

When operating in stratified mode the electronic throttle valve is held continuously open by the ECU. At the same time the tumble flaps are positioned to block off the lower channel. This action causes the incoming air to flow mainly over the upper edge of the inlet valve, which causes a pronounced tumble or swirling movement within the induced air.

As the piston starts to move upward on its compression stroke, the air swirl recess within the piston intensifies the tumbling air movement. Moreover, as it approaches top dead centre the air is continuously swirling similar to a whirlwind. It's at this moment that the fuel is injected directly into the piston's fuel recess, which causes the fuel to swirl in the opposite direction to the spiralling air.

As the piston nears the last quarter of its stroke, the swirling air, together with the swirling fuel, causes a small ball of ignitable charge to be formed around the spark plug. The ball is known as the stratified charge, which is then ignited and the burning process takes place directly beneath the





spark plug. Note, when running in stratified charge mode, the electronic throttle valve is almost fully open. Engine power is then controlled by regulating the amount of fuel being injected, which again is similar to a diesel engine.

When changing to the homogenous combustion mode the throttle valve repositions to match the position of the accelerator pedal. At the same time the tumble flaps are deactivated to direct the induced air through both of the inlet channels.

As the air is drawn into the cylinder (during the induction stroke), the fuel is injected directly into it. Injecting at this earlier part of the engine cycle allows the fuel time to fully mix with the air, which results in the premixing of the whole charge. The piston then returns on its compression stroke and just before top dead centre the charge is ignited.

It's the engine management's function to decide which mode is best suited to the driving conditions, but the rules are straightforward. At cruising speeds and at light throttle the engine runs mainly in stratified mode and under load or acceleration, it's switched to homogenous operation. The switchover occurs so smoothly that it's undetectable to the driver.

When operating with stratified combustion the lambda value of the engine is 1.6 - 4.0, which is so weak that the charge would fail to ignite if it was mixed homogeneously. Therefore, at part throttle, there's a potential fuel saving of up to 15% and yet by automatically switching to Homogenous mode when needed, the engine maintains an impressive power output.

Emissions

When operating in stratified combustion mode these engines operate at extremely

weak mixtures (as mentioned their lambda value is between 1.6 to 4.0), such weak mixtures cause high combustion temperatures, hence their efficiency.

Weak mixtures also reduce carbon monoxide and hydrocarbon emissions. However, when it comes to other pollutants, high combustion temperatures can be a disadvantage as they cause more of the nitrogen that would normally pass through the cylinder unburned, to be burnt.

The emission control system has six main sections or components:

- ▶ Control lambda sensor
- ▶ Primary three-way catalytic converter (close to engine)
- ▶ Exhaust gas temperature sensor
- ▶ NOx storage catalyst
- ▶ Diagnosis lambda sensor
- ▶ NOx sensor

The control lambda sensor used is always of the wideband type. The output signal from this type of sensor differs from that of a traditional lambda sensor. Traditional sensors produce a voltage that constantly changes between 0.2 to 0.8 volts as the exhaust gas crosses lambda one. Wideband sensors produce an almost linear varying current; this allows the lambda value to be measured over a wider measuring range, hence the name wideband.

The main function of this wideband sensor is to maintain 'lambda one' whilst the engine is running in homogenous mode. Just like any petrol engine, maintaining lambda one is necessary for the primary three-way catalyst to efficiently reduce any

NOx emissions from the exhaust. However, if the engine is allowed to run weaker than lambda one, whilst in stratified mode for example, excess oxygen becomes present in the exhaust gas and therefore, a three way catalyst stops converting NOx.

When running in the stratified mode the catalyst only functions as an oxidation catalyst. This means that the NOx is not dealt with! So to reduce NOx emissions a second converter, known as a NOx storage catalyst is used.

Although the NOx storage catalyst consists of a slightly thinner honeycombed core, it's very similar in design to a conventional three-way catalyst. The core is covered with a wash-coat containing the same precious metals, platinum or palladium and rhodium, which means it also operates as a conventional three-way cat.

To overcome this problem, a third substance, Barium oxide, is used within the cat. It absorbs the NOx and holds it in the catalyst. The catalyst soon becomes full, a situation that's quickly detected by the NOx sensor. The sensor's signal is received by its own control unit and is then passed on to the engine management system. In response, the engine is instantly switched to operate in homogenous mode.

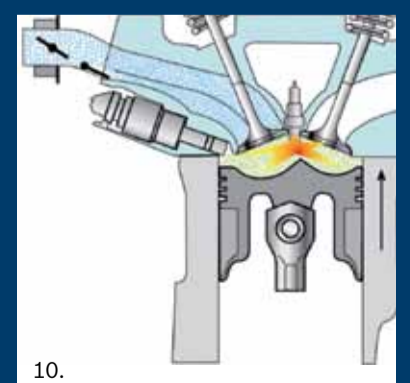
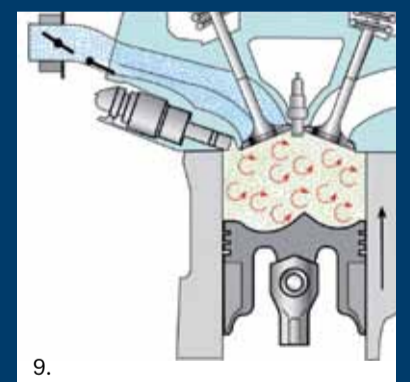
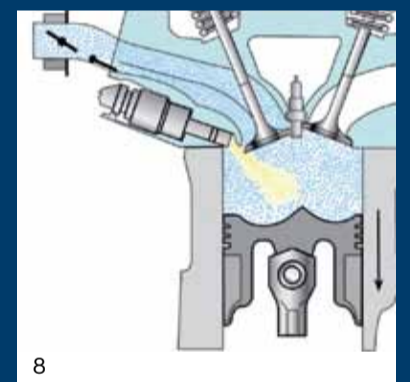
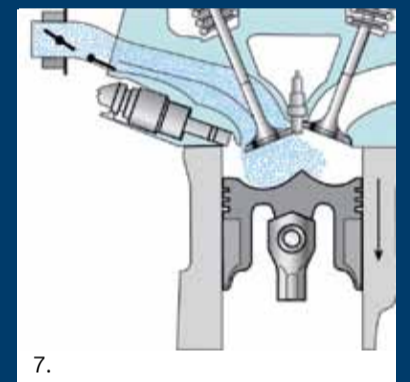
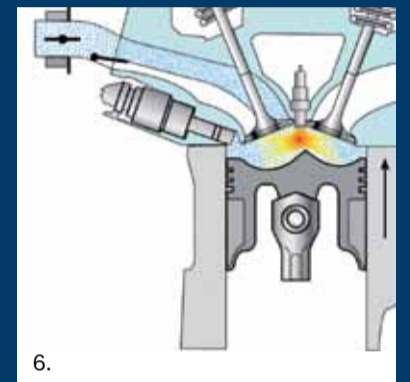
Changing back to homogenous mode returns the engine to lambda 1.0 and instantly removes the excess oxygen from the exhaust gas. As a result, the rhodium within the catalyst starts its reduction process and the NOx is converted into oxygen and nitrogen. It's all made possible by the NOx sensor that constantly monitors the build-up of NOx within the storage catalyst.

Once full, it only takes 2 seconds of homogenous running to completely empty the catalyst of NOx. However, if the control unit detects that the time taken to fill the storage catalyst with NOx is ever decreasing, then it's possible that the catalyst is filling up with sulphur. To remove the sulphur the engine is returned to homogenous mode and the ignition timing is retarded until the temperature of the catalyst is increased to above 650 °C. Only then is the stored sulphur converted into sulphur dioxide and removed. To increase the amount of time that the engine runs in stratified mode and thus reduce fuel consumption, the use of sulphur free fuels should always be encouraged with GDI engines.

To function efficiently, the NOx storage catalyst requires exhaust gas temperatures in the region of 250 to 500 °C. So, to keep temperatures correct, the system also incorporates an exhaust gas temperature sensor. The sensor is constantly monitored by the ECU. When the engine is operating in stratified mode and the exhaust gas temperatures become too high, the engine is instantly returned to homogenous operation.

The diagnosis lambda sensor is used for EOBD only and is used to detect a faulty primary catalyst.

It's the engine management's duty to decide which mode is best suited to the driving conditions.



If you would like to learn more about this topic, the relevant Bosch training course is **Gasoline Direct Injection System Diagnosis**. The course code is VSG 11, if you are interested in attending this highly acclaimed course please contact Bosch Training on **01895 978032** or e-mail **saa.training@uk.bosch.com**



Ini-Philip Enyiekere
Product Specialist:
Glow Plugs

Glowing report

Bosch says quality glow plugs are vital to ensure fast, reliable starting from diesel vehicles.

Diesel drivers expect their cars to start immediately, at the first turn of the key, just like a gasoline-powered vehicle, whatever the temperature. Glow plugs play a vital role in meeting those expectations. Low-cost options do not offer a long-term solution however.

Quality counts

Fitting poor quality glow plugs could result in an engine which has difficulty starting or does not start at all. The most frequent causes of problems are overheated, corroded, melted or broken glow plugs as well as dents and creases on the heating element, or no continuity. There are a number of possible causes for these glow

plug problems, for example: the start of injection being too early, increased alternator voltage or worn injection nozzles.

Modern engine requirements

As a system developer and supplier, Bosch understands the need for the glow system to be integrated optimally into the overall engine management. As is now the case with any system or component on a modern vehicle, a great deal of technology and development are applied to achieve the necessary performance.

DuraSpeed

The DuraSpeed glow plug uses technological advances to meet the needs

of modern diesel engines that need to comply with stricter emissions values whilst providing better fuel economy, but still maintaining performance and power output. One of the ways that vehicle manufacturers have achieved this is by lowering the engine's compression ratio, however, at lower compression ratios it's more difficult for the diesel/air mixture to auto-ignite, which can lead to big problems in colder climates such as the UK.

This issue is resolved by making the glow systems and glow plugs play a more significant role in the diesel combustion – even when the engine is still running.

How does DuraSpeed meet these requirements?

- ▶ To ensure smooth combustion, DuraSpeed plugs have a ceramic core that allows the plug to achieve higher glow temperatures and maintain these for longer.
- ▶ To comply with strict emission levels throughout the life of the engine, the high quality DuraSpeed ensures continued performance that complies with OEM service schedules.
- ▶ For the regeneration of the particulate filter (a major issue in urban traffic), the DuraSpeed offers the durability to stabilise combustion.
- ▶ 100% compatibility with automatic start-stop (micro-hybrid) systems due to low power consumption, very short heating time, optimised heating zone and superior reliability.
- ▶ DuraSpeed provides optimum fuel combustion and so reduces engine sooting while at the same time delivering maximum reliability from Bosch.



Starting problems due to an overheated or corroded heating element tip

Complaint:

Engine will not start/starting poorly

Symptoms:

Heating element tip overheated or corroded

Possible cause:

Start of injection too early



Dents and creases on the heating element causing starting problems

Complaint:

Engine will not start/starting poorly

Symptoms:

- ▶ Heating element creased and dented
- ▶ Break in heater filament

Possible cause:

- ▶ Operation at excessively high voltage (e.g. jump-starting)
- ▶ Current applied for too long
- ▶ Increased alternator voltage
- ▶ Impermissible post-heating with engine running
- ▶ Glow plug without post-heating capability fitted



Poor engine performance due to melted or broken heating element

Complaint:

Engine will not start/starting poorly

Symptoms:

Heating element melted or broken due to overheating

Possible cause:

- ▶ Start of injection too early
- ▶ Dripping injection nozzle
- ▶ Coked/worn injection nozzles
- ▶ Sticking piston rings
- ▶ Engine damage



If the glow plug has no continuity, the engine will start poorly or not at all

Complaint:

Engine will not start/starting poorly

Symptoms:

- ▶ No glow plug continuity
- ▶ Break in heater filament

Possible cause:

- ▶ Closed-up/coked annular orifice between plug shell and heating element
- ▶ Heating element discharging too much heat
- ▶ As a result, the regulator filament remains cold and allows too much current through to the heater element